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RESEARCH ARTICLE

Constraint experienced by farmers in the adoption of protected cultivation practices

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Abstract

As an innovative way of cultivating seasonal and off-seasonal crops, protected cultivation has enormous potential for improving productivity, generating employment and ensuring effective utilization of land. However, its adoption remains low due to several constraints faced by the farmers during adoption. In this regard, the present study aims to identify and assess these constraints using the Henry Garrett ranking technique among 120 farmers from Krishnagiri and Dharmapuri districts under five different dimensions. It can be concluded that the rapidly growing population, declining cultivable land, increased pests and diseases, rising pollution levels, global warming and changing climate all underscore the importance of sustainable agriculture, along with the need for higher crop productivity through protected cultivation techniques. Hence, the government and policymakers should take necessary steps to eliminate these constraints and promote adoption of protected cultivation.

Keywords: challenges; future prospects; innovations; protected cultivation

Introduction

Protected cultivation is a high-tech method of growing crops under a controlled environment by managing temperature, humidity, light and other key plant growth factors according to the crop's needs. This is achieved through the use of innovative structures such as polyhouses, net houses, tunnels, trellises, greenhouses or protective measures like windbreaks, irrigation and mulches.

To serve the purpose, the protected cultivation system employs transparent materials like polythene or glass to trap infrared radiation, that positively impacts photosynthetic rate as a result of increased interior temperature (1-3). Additionally, it employs a variety of strategies, such as mulching, drip irrigation and fertigation (3). Cooling devices also help to control the temperature, encouraging fast development and higher output (4, 5). This method is effective for growing crops such as decorative plants, tomatoes, cucumbers, cucurbits, sweet pepper, brinjal, carnations, tuberoses, gerberas, roses, fruits such as grapes, apple, pear, peach, plum, cherry, strawberry and other berry crops (1, 6-9). In India, around 11000 ha are under protected cultivation of horticultural crops (10).

The establishment of protected cultivation structures has become inevitable in areas with harsh weather conditions or little arable land, as it enables the farmer to protect the crops from biotic (pests and diseases) and abiotic (extreme weather conditions, excess or lack of water and so on) factors that affect crop productivity and quality (11, 12). In addition, it also enhances the quality of the agricultural produce, improve yield and increases profitability for the farmers by creating a regulated microclimate that protects the crops from adverse weather and harmful pests and diseases (13-15).

By controlling the factors like temperature, humidity and light, protected cultivation techniques ensure year-round or off-season farming by lengthening the growing season, improving crop quality and output and reducing the dependency on outside variables (13). In addition, protected cultivation techniques ensure production of higher quality off-season crops, increase yield through close planting and a steady supply of fresh produce in peri-urban areas through multi-story crop growing at significantly cheaper cost of production (6, 14, 16-19) there fore, protected cultivation is recognized as a sustainable agriculture practice because it enables controlled and efficient input use.

The high cost of the initial investment, lack of technical expertise among small-scale farmers, sustainability issues; the existence of root-knot nematodes; increased pest occurrence due to favourable weather conditions within greenhouses; lack of varieties especially for greenhouses, high cost of exotic seeds;

inadequate infrastructure, weak market linkage, knowledge gap in implementation of protected cultivation; short life of poly sheets; infestation of insect-pest; high price fluctuations and lack of market information; lack of awareness among farmers about the potential of protected vegetable cultivation and lack of significant research programmes were the most serious constraints affecting the adoption of protected cultivation (20-24).

Meanwhile, several listed challenges to adopting protected cultivation in India. These include a lack of trained professionals and skilled workers for designing and building structures, the absence of region-specific designs for different agro-climatic zones, limited practical training and advisory services and cultivation not based on market demand, which leads to low prices and increased problems like soil-borne fungi and root nematode infestation.

In the context of climate change, both abiotic and biotic stressors affect crop productivity, while, protected cultivation techniques help overcome these constraints by controlling the environment and other important plant growth factors. Rapidly increasing population and declining cultivable land emphasize the importance of protected cultivation. However, adoption of protected cultivation remains low among farmers, therefore, it is important to understand the factors that restrict the adoption of protected cultivation among farmers. In this regard, the present study aims to identify and assess the constraints faced by farmers in adopting of protected cultivation practices.

Materials and Methods

The present study was conducted in the Krishnagiri and Dharmapuri districts of Tamil Nadu, since the farmers of those districts had adopted protected cultivation a few years ago, which facilitated a better understanding of the constraints they experienced. From each district, 60 farmers who had adopted protected cultivation in the last five years were selected for the study. The various constraints experienced by the farmers in adoption of protected cultivation were identified through previous literature, expert opinions or better understanding. These constraints were categorized under different groups such as marketing constraints, economic constraints, social constraints, technical constraints and supply constraints (Fig. 1). Data were collected from the farmers through personal interviews with the help of a structured questionnaire during May 2025. During data collection, the farmers were requested to assign a rank to each constraint based on their observation and the analysis was carried out as per Henry Garrett Ranking technique (25).

Data Analysis

Calculation of Garret score using percent position

Since there are four statements/ factors under each dimension. The Garret score was identified for each rank from the Garret ranking conversion table by using the Percent Position formula.

The formula to calculate percent position was

$$\text{Percent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij} - Rank given for the i^{th} variable by the j^{th} respondent

N_j - Number of ariable ranked by the j^{th} respondent.

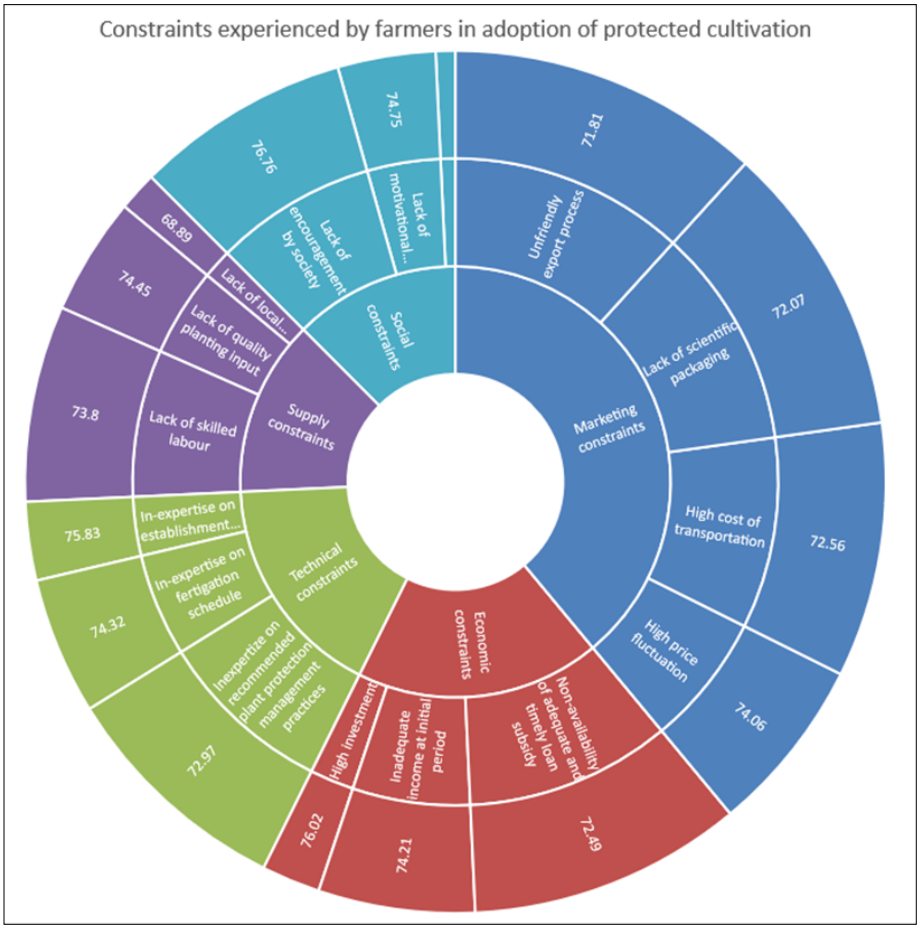


Fig. 1. Constrains faced by farmers in adoption of protected cultivation.

Results and Discussion

The identified Garrett score of each rank was multiplied with the frequency of each rank to find the total Garret score (Table 1). Table 2 presents the Garret scores identified through Garrett ranking conversion table. The average of the total Garrett score was calculated and the ranks were assigned to each dimension as well as constraint, which are presented in Table 3.

Table 3 presents the various constraints experienced by the farmers practicing protected cultivation. Under marketing constraints, a higher percentage of the farmers reported price fluctuations of the produce as the topmost constraints, with a Garret mean score of 74.06, followed by the high cost of transportation as the second most important constraint (72.56), lack of scientific packaging of produce as the third (72.07) and unfriendly process in export was the least important marketing constraint (71.81).

Regarding economic constraints, it was observed that high investment required for the establishment of the protected cultivation was the foremost constraint, with a Garret mean score of 76.02, followed by inadequate income during the initial period (74.21), non-availability of adequate and timely loan subsidies (72.49) and high input cost (71.13) as other important economic challenges. With respect to technical constraints, lack of expertise in establishing polyhouses was identified as the most serious constraint in adopting of protected cultivation (75.83), followed by lack of expertise on fertigation scheduling (74.32), limited expertise in recommended plant protection management practices (72.97) and lack of knowledge regarding sources of planting material (69.79).

In terms of supply constraints, the major issue faced by farmers practicing protected cultivation was the non-availability of recommended pesticides (76.28). Other important constraints included lack of quality planting inputs (74.45), shortage of skilled labour (73.80) and absence of local repair services (68.89). Regarding social constraints, the main issue was lack of encouragement by society, with a mean Garrett score of 76.76, followed by lack of motivational factors (74.75), lack of family support (73.45) and fear of failure due to the absence of successful role models (70.33).

Thus, the findings of the study revealed that price fluctuations of the produce were the major marketing constraint, high initial investment requirements were the most critical economic constraint, lack of expertise in polyhouse establishment was the most serious technical constraint, non-availability of recommended pesticides was the most important societal constraint.

Since society plays a vital role in shaping any human's efforts, lack of societal encouragement acts as threat to farmers, discouraging them and causing them to discontinue the practice from others. Similar studies also reported that the high initial investment cost and lack of expertise in polyhouse establishment are major challenges for farmer adopting protected cultivation. As the farmer often lacks experience and technical skills in the system, they tend to be hesitant to invest a large portion of their income or savings in a relatively unfamiliar technology.

Table 1. Constraints experienced by farmers in adoption of protected cultivation practices

Dimension	Constraints	Rank given by farmers			
		1st	2nd	3rd	4th
Marketing constraints	High price fluctuation	75	19	15	11
	Export process unfriendly	67	22	18	13
	Lack of scientific packaging	63	28	20	9
	High cost of transportation	65	31	12	12
Economic constraints	High investment	83	15	12	10
	Inadequate income at initial period	77	12	23	8
	High input cost	64	21	24	11
	Non-availability of adequate and timely loan subsidy	63	30	19	8
Technical constraints	In-expertise on establishment of polyhouse	84	15	8	13
	In-expertise on fertigation schedule	75	21	13	11
	In-expertise on recommended plant protection management practices	64	29	21	6
	In-expertise on the source for planting material	61	26	15	18
Supply constraints	Lack of local repair services	59	26	15	20
	Non-availability of recommended pesticides	85	15	8	12
	Lack of quality planting input	74	23	13	10
	Lack of skilled labour	69	23	23	5
Social constraints	Lack of encouragement by family	75	18	13	14
	Lack of motivational factors	67	36	11	6
	Lack of encouragement by society	87	13	9	11
	Fear of failure due to lack of successful role models	64	21	19	16

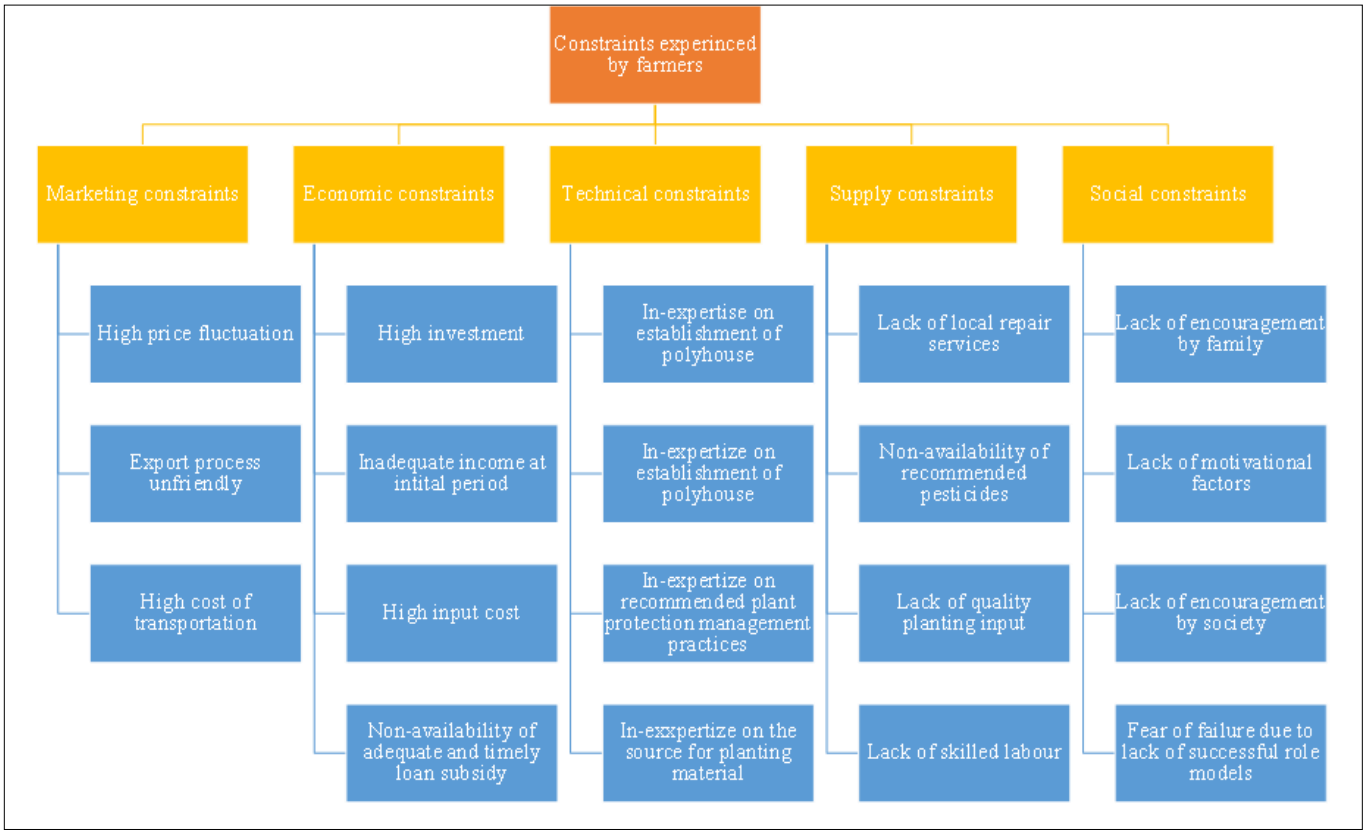
Table 2. Percent value and Garrett score

Percent position	Percent value	Garret score
100 (1-0.5)/4	12.50	72
100 (2-0.5)/4	37.50	56
100 (3-0.5)/4	62.50	43
100 (4-0.5)/4	87.50	27

Table 3. Calculation of Garrett score and ranking of constraints

Dimension	Constraints	Garret mean score	Rank within dimension	Overall rank
Marketing constraints	High price fluctuation	74.06	I	9
	Export process unfriendly	71.81	IV	16
	Lack of scientific packaging	72.07	III	15
	High cost of transportation	72.56	II	13
Economic constraints	High investment	76.02	I	3
	Inadequate income at initial period	74.21	II	8
	High input cost	71.13	IV	17
	Non-availability of adequate and timely loan subsidy	72.49	III	14
Technical constraints	In-expertise on establishment of polyhouse	75.83	I	4
	In-expertise on fertigation schedule	74.32	II	7
	Inexpertize on recommended plant protection management practices	72.97	III	12
	In-expertise on the source for planting material	69.79	IV	19
Supply constraints	Lack of local repair services	68.89	IV	20
	Non-availability of recommended pesticides	76.28	I	2
	Lack of quality planting input	74.45	II	6
	Lack of skilled labour	73.80	III	10
Social constraints	Lack of encouragement by family	73.45	III	11
	Lack of motivational factors	74.75	II	5
	Lack of encouragement by society	76.76	I	1
	Fear of failure due to lack of successful role models	70.33	IV	18

Framework depicting the constraints experienced farmers in practicing protected cultivation



Conclusion

Protected cultivation is a useful technology that requires less water and fewer pesticides. It helps farmers grow fresh produce in greenhouses near cities, even beyond the normal growing seasons, with improved yield quality and higher profitability. Furthermore, it reduces seed production time and helps to cultivate exotic fruits, vegetables and flowers such as carnations, tuberoses, gerberas and roses, thereby meeting the increasing demand of growing population amid declining cultivable land. Hence, it was concluded that the multiple potentials of protected farming techniques are essential to meet the increasing food demand of world's population. Moreover, the profitability of the protected cultivation should be promoted as an agribusiness opportunity among farmers through training and capacity-building programmes.

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Authors' contributions

ME took the lead in conducting the survey, analyzing the data and was chiefly responsible for writing the manuscript. PSR provided support in data collection and contributed to the analytical components of the study. AM was instrumental in developing the research framework, reviewing the manuscript and securing research funding. KLD helped organize the content and refine the draft, while MM contributed to summarizing the findings and offered ongoing support throughout the research process. All authors read and approved the final version of manuscript.

Compliance with ethical standards

Conflict of interest: The Authors do not have any conflict of interest to declare.

Ethical issues: None

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